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STATEMENT #2 UNCLASSIFIED

DEPARTMENT OF THE ARMY  
Fort Detrick  
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*Arthur T. Lohman*

POTENTIALS FOR FURTHER INCREASING THE WHEAT  
PRODUCTION IN OUR COUNTRY

Geoponika, Nos. 112-113,  
November-December 1963,  
Salonika, Greece, pp 279-290

B. F. Kokolios, Director  
of the Cereal Institute

The small number of agricultural areas which are now becoming even smaller due to the continuous increase of our agriculture population, demands intensified wheat cultivation and an increase in the wheat yields to such a degree as to allow the survival of this continuously increasing agricultural population. This intensification of soil cultivation could, and should include all plants, as there are great possibilities of increasing their yield by the use of new methods based on a more scientific and reasonable exploitation of the soil.

Among the various plants whose yield could be increased are the cereals, i.e., wheat, barley, oats, corn and rice.

We should, however, emphasize that during recent years the cultivation of cereals has improved considerably and today's yield is better than that of a few years ago. Nevertheless, the yield of the above-mentioned cereals are not as high as they could be, according to the climatic and geological conditions of our country. The ecological environment of our country calls for a much higher yield.

What improvements were noted during the last years in the cultivation of wheat in our country?

According to the statistics of the Ministry of Agriculture, the wheat yield in our country thirty years ago was between 60-70 kilograms per acre. Since then the wheat yield per acre has increased. In 1957-1963 it reached 150-160 kilograms.

CHART 1  
Wheat Yield Per Acre

YEAR	YIELD	YEAR	YIELD
1919	62	1939	100
1920	70	1945	62
1921	73	1946	96
1922	57	1947	68
1923	56	1948	95
1924	45	1949	110
1925	66	1950	98
1926	64	1951	98
1927	71	1952	99
1928	66	1953	134
1929	62	1954	118
1930	47	1955	129
1931	50	1956	118
1932	77	1957	157
1933	111	1958	162
1934	88	1959	153
1935	87	1960	146
1936	64	1961	151
1937	95	1962	155.5
1938	114		

The increase in the production of wheat by almost 90 kilograms within thirty years should be attributed to the improved methods of cultivation used by our farmers during the last years, and also the wide use of improved varieties and selected seeds of these varieties in use in the various areas.

However, despite this important increase of wheat yield during the past thirty years, our country's development and progress in wheat production is very retarded particularly when we take into consideration the recent progress of other foreign countries such as France, Italy, Canada, United States, and others.

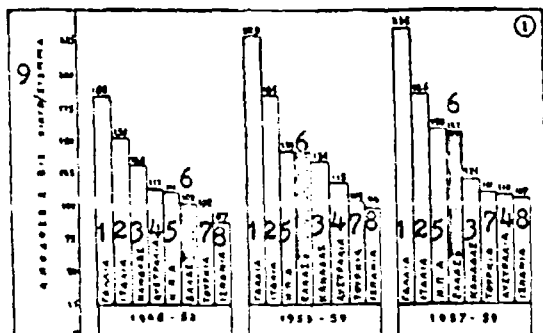
The statistics below supply us with a picture of the developments which have taken place in some foreign countries and in our country.

CHART 2  
Wheat Yield in Kilos. of Some Foreign  
Countries and of Our Country

COUNTRIES	1943	1953	1957
	1952	1959	1959
1. Albania	94	-	106
2. Austria	171	217	217
3. Belgium	322	347	367
4. Bulgaria	124	148	167
5. Czechoslovakia	190	194	205
6. Denmark	365	387	398
7. France	183	228	235
8. Germany, West	262	296	312
9. Germany, East	-	348	304
10. Greece	102	139	157
11. Hungary	138	142	151
12. Italy	152	185	186
13. Holland	365	381	391
14. Poland	125	151	162
15. Portugal	72	86	89
16. Rumania	102	106	119
17. Spain	87	99	107
18. Sweden	209	233	231
19. Switzerland	265	303	315
20. Great Britain	272	316	328
21. Yugoslavia	120	132	159
Average - Europe	147	171	182
22. Canada	128	133	121
23. U.S.A.	111	139	158
24. Argentina	115	132	131
25. Brazil	74	74	56
26. Chile	119	129	136
27. China (22 areas)	96	-	180
28. Turkey	100	103	111
29. Egypt	184	227	233
30. Japan	185	218	224
31. Algiers	-	67	66
32. India	66	74	72
33. Australia	112	115	110

From the above statistics, we can conclude that our country is definitely behind France and Italy in wheat yield per acre, but Greece, nonetheless, is ahead of such countries as Spain, Turkey, Portugal and Australia and is almost in the same position as Canada, U.S.A., etc.

GRAPHIC CHART NO. 1  
Average Wheat Yield in Kilos. Per Acre in Some  
Foreign Countries and in Our Country



Legend:

- 1 - France
- 2 - Italy
- 3 - Canada
- 4 - Australia
- 5 - U.S.A.
- 6 - Greece
- 7 - Turkey
- 8 - Spain
- 9 - Yield in kilos/acre

The above statistics show by chronological periods the wheat yield in our country and in other foreign countries such as France, Italy, Canada, U.S.A., Australia, Turkey and Spain.

The higher wheat yield of some countries as compared to that of Greece and especially those in the neighboring Mediterranean countries of Italy and France, are due partly to the better environment for wheat existing in these countries, and partly to the fact that these countries use widely improved methods for the cultivation of cereals, while most of our country lacks these improved methods. The increase of wheat production in some foreign countries such as France during the last few years (which resulted in a 50% increase of wheat yield per acre as compared to the pre-war yield) is due to the use of new and improved varieties, especially the variety "Etoile de choisy" in South France, and the variety "Cappelle" in North France. This increase in wheat yield is also due to excellent fertilization.

Italy, the second wheat producing Mediterranean country, has also made great progress in wheat production through the use of new varieties, improved technical cultivation and especially the wide use of fertilization which has almost been generalized during the past few years.

The continuous increase of wheat yield as compared to the pre-war years in Canada, U.S.A., and other countries, should be attributed to the improvement of wheat production measures taken by these countries. For instance, the use of only improved varieties with constantly controlled productive potential; the merchandising and circulation of varieties and better quality seeds which resulted in a constant qualitative and quantitative improvement of cereals in these countries.

By comparing the above statistics regarding the development of wheat yield during the past few years in our country and in a few foreign countries, we can conclude that although our country has made significant progress in wheat production, it still lags behind many other countries. Because of this, our country is significantly low in wheat yield despite the fact that its soil, climate and in general its productive potential is not very different from that of the other countries.

This low wheat yield of our country is due mainly to the fact that unlike other foreign countries, we have not yet generalized the improved techniques of wheat cultivation. We can easily increase our wheat yield if we distribute the improved techniques of cereal cultivation dictated by the conclusions reached through the experiments for the intensification of cereal cultivation. By the generalization of the improved techniques in cereal cultivation, the wheat yields which are now 150-160 kilograms per acre will be increased and surpass even 200 kilograms per acre. We are now far below the maximum potential of wheat yield allowed by the ecological environment of our country. Holland and Belgium have a wheat yield of about 400 kilograms per acre; France about 250; Italy easily over 200 kilograms; Greece should definitely come close to 200 kilograms per acre.

#### FACTS ON WHICH THIS FURTHER INCREASE OF OUR COUNTRY'S WHEAT YIELD MAY BE BASED UPON

We have said earlier that the further increase of the wheat yield in our country is quite possible. But what are the facts upon which we base this prediction?

The possibility of further increase of wheat yield in our country is based on the following facts:

A. The latest experimental data of the Institute of Cereals.

B. The high wheat yield produced by some progressive farmers who cooperated with the Institute and who followed patiently the suggestions of the Institute and produced a much higher average yield than others in our country.

#### A. INSTITUTE DATA ON EXPERIMENTAL WHEAT YIELDS

1. Sixteen years of experimental data (1947-1962) at the Central Institute field, shows that a wheat yield of 225 kilograms per acre was achieved despite the fact that the above-mentioned field was in a very poor ecological environment. The soil was sand-clay, very absorbant and dry, and the climate was dry-hot with very little rain, especially during the critical period of the growth of the stem and the seed. The corresponding statistical data of wheat yield in Greece during the same period of time shows an average of 125 kilograms, i.e., much lower than

the potential yield of 225 kilograms, i.e., about the same as the yield achieved by the experimental station whose soil, in respect to fertility and climate, is inferior to that of the average field in Greece.

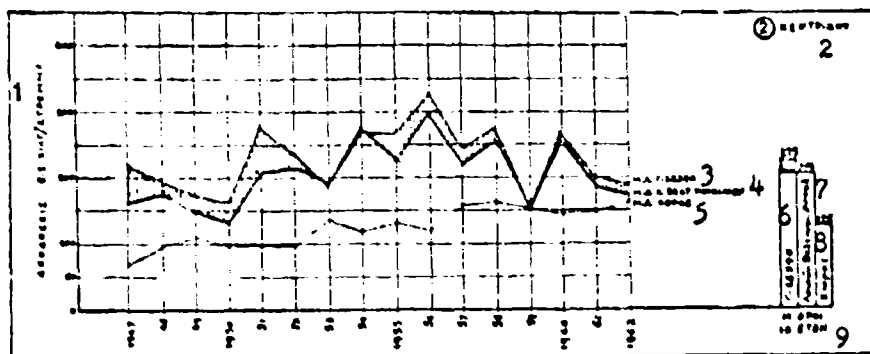


Diagram 2.

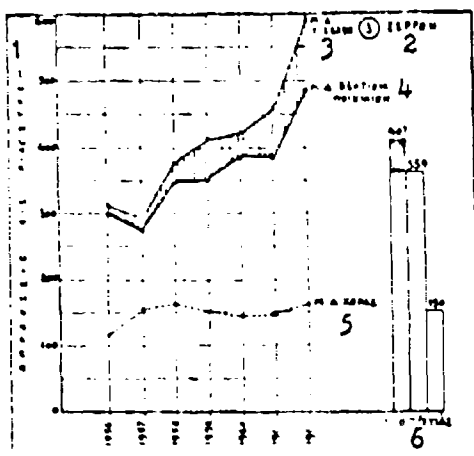
Comparison of the average yield G-38290 with the average yield of the various varieties in experiments at the Central Institute with the average yield of the country during 1947-1962. Legend: 1 - Yield in kilos/acre; 2 - Central Institute; 3 - Average of G-38290; 4 - Average of other varieties; 5 - Average of the country; 6 - G-38290; 7 - Other varieties; 8 - Country; 9 - 16-year average.

2. Experimental data during the period 1956-1962 at Serrai, Larissa, and Messara where the fields are fertile and moderately fertile with regular rainfall, show that the wheat yield in these areas could easily reach 407, 317 and 275 kilograms per acre. These were the average wheat yields achieved in experiments at the sub-stations of Serrai, Larissa and Messara during the period of 1956-1962.

3. Experimental data during the period 1956-1962 at the experimental stations of Douroute, Tripolis and Ptolemais in very poor soils (Douroute and Tripolis) with regular rainfall, and in an area of fertile soils (Ptolemais) also with regular rainfall, show that areas close to these experimental stations can substantially increase their wheat yield, i.e., they can reach a yield of 227, 236 and 298 kilograms which the experimental stations of these areas reached during the above-mentioned seven year period.

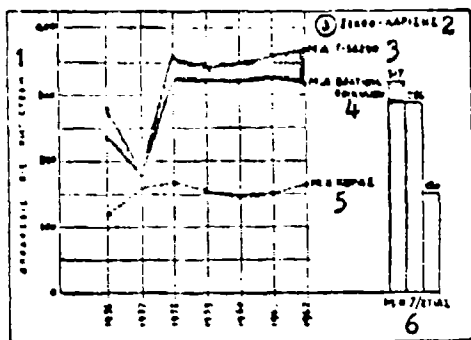
4. Six years of experimental data (1956-1962) at the Kopais field which has a fertile soil and regular rainfall, show that by using an improved variety and the necessary care the wheat yields in areas close to our experimental ecological environment could reach 349 kilograms per acre. This was the yield achieved by our experimental Kopais stations from 1956-1962.





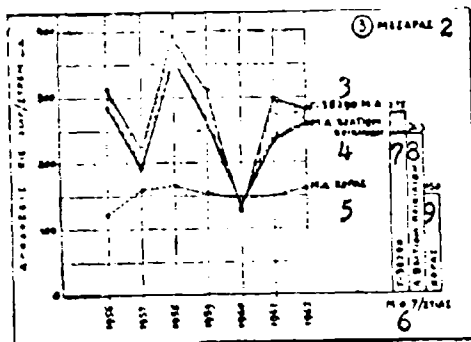
Legend:

- 1 - Yield in kilos/acre
- 2 - Serrai
- 3 - Average G-38290
- 4 - Average improved varieties
- 5 - Average of the country
- 6 - 7-year average



Legend:

- 1 - Yield in kilos/acre
- 2 - Larissa
- 3 - Average G-38290
- 4 - Average improved varieties
- 5 - Average of the country
- 6 - 7-year average

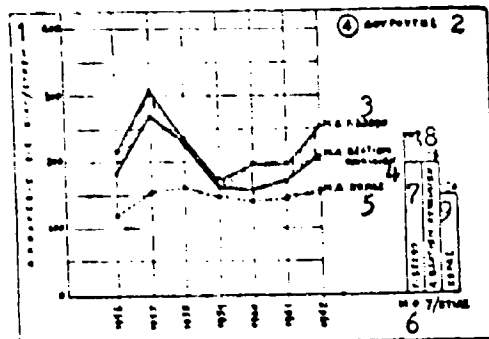


Legend:

- 1 - Yield in kilos/acre
- 2 - Messara
- 3 - Average G-38290
- 4 - Average improved varieties
- 5 - Average of the country
- 6 - 7-year average
- 7 - G-38290
- 8 - Improved varieties
- 9 - Country

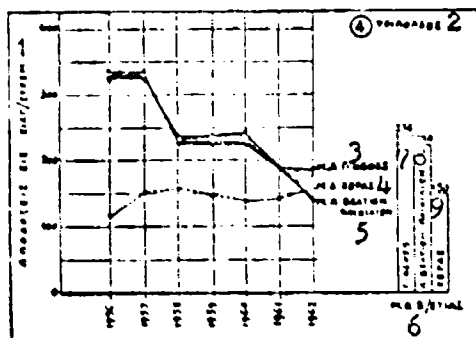
Diagram 3.

Comparison of the average yield of G-38290 with the average yield of the other varieties at the experimental stations of Serrai, Larissa, Messara, as compared with the average yield in the country during the period 1956-1962.



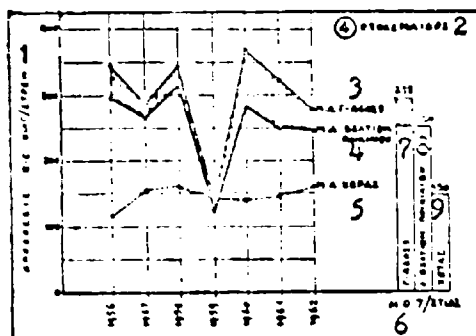
Legend:

- 1 - Yield in kilos/acre
- 2 - Douroute
- 3 - Average G-38290
- 4 - Average improved varieties
- 5 - Average of the country
- 6 - 7-year average
- 7 - G-38290
- 8 - Improved varieties
- 9 - Country



Legend:

- 1 - Yield in kilos-acre
- 2 - Tripolis
- 3 - Average G-46025
- 4 - Average of the country
- 5 - Average improved varieties
- 6 - 5-year average
- 7 - G-46025
- 8 - Improved varieties
- 9 - Country



Legend:

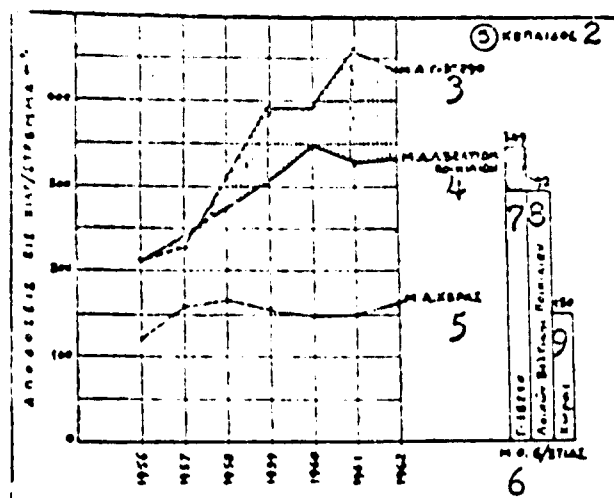
- 1 - Yield in kilos/acre
- 2 - Ptolemais
- 3 - Average G-46025
- 4 - Average improved varieties
- 5 - Average of the country
- 6 - 7-year average
- 7 - G-46025
- 8 - Improved varieties
- 9 - Country

Diagram 4.

Comparison of the average G-46025 and G-38290 yield with the average yield of other varieties at the experimental stations of Douroute, Tripolis, and Ptolemais, as compared with the average yield of the country during the period 1956-1962.

The above statistics of average yields in the Institute's Central Office, its substations and the other experimental fields, demonstrate the potential yield of the Greek fields per acre when they are cultivated, sown, and cared for in the proper manner. It is understood that the soils used in these experiments represent the various types of soils

in our country, i.e., poor, moderate, rich, etc., and they have an average climate in relation to the ecological climate of the wheat-producing fields of Greece.



Legend:

- 1 - Yield in kilos-acre
- 2 - Kopais
- 3 - Average G-38290
- 4 - Average improved varieties
- 5 - Average of the country
- 6 - 6-year average
- 7 - G-38290
- 8 - Other improved varieties
- 9 - Country

Diagram 5.

Comparison of the average yield of G-38290 with the average yield of the other varieties at the experimental station Kopais as compared with the average yield in the country during the period 1956-1962.

From the study of the above-mentioned statistics of our experiments we may conclude that we should in the future expect wheat yields similar to the experimental ones, although, due to the great difference between the experimental yields and the general yields, greater effort will be needed before the two yields are equalized. Nevertheless, despite the great efforts that will be required, the task seems within our potentials as long as it is spread out over a reasonable number of years and the whole task is programmed widely enough to cover the technical indoctrination of the farmer.

Thus, with the proper programming of the whole task, the use of proper means, and the technical indoctrination of our farmers, the possibilities of success increase accordingly, and while the wheat yields of 200 kilograms and 250 kilograms look impossible today, they will be a definite reality tomorrow.

In summary, the following conclusions are reached by comparing the yields achieved by our long experimentation with the yields based on the official statistics of our country during the periods of 1947-1962, and 1956-1962.

a. During the periods 1947-1962, the average wheat yield in Greece was 125 kilograms per acre, and the yield in the experiments of

our Central Office with a very poor ecological environment for wheat, was 225 kilograms, i.e., 100 kilograms more than the average yield in the country (Diagram 2).

b. During the periods 1956-1962, the average yield in Greece rose to 150 kilograms per acre; in the experimental stations of Serrai, Larissa and Kossara, it rose to 407, 317 and 275 kilograms; in the experimental stations of Douroute, Tripolis and Ptolemais, it rose to 227, 236 and 293 kilograms. In all the experimental stations, including Douroute whose fields are the poorest in the country, the average yield was much higher than the average in the country (Diagrams 3 and 4).

c. During the periods 1956-1962, the annual yield in Greece reached 150 kilograms while at the experimental stations of Kopais, it reached 349 kilograms (Diagram 5).

The great differences mentioned above between the yields at the experimental stations of the Institute and the yields of the various fields in the country cultivated by common farmers, is mainly due to the use of special technology by the Service which takes advantage of all the productive potentials of the soil. Unfortunately, a great number of our farmers did not take advantage of these potentials and produced a much lower yield than those of the experimental stations and a lower yield than the expected potential of these fields.

The majority of our farmers could use this technology to achieve yields higher than they are achieving now, they may even use it with a greater success than the Institute.

#### B. YIELD DATA OF PROGRESSIVE FARMERS

According to our long observation some wheat producers of our country using fields of moderate fertility and following the cultivation instructions of our Service, never received, during the last fifteen years, yields lower than 250 kilograms. This fact proves that the average yield of 225 kilograms achieved by the Central Institute during the last fifteen years is not an imaginary one but a real one; therefore, all farmers of our country should strive for the average of 250 kilograms achieved by these few progressive farmers.

Of course not all farmers will be able to achieve the above-mentioned average yield despite the fact that the potentials of the fields of our country call for the average of 250 kilograms; some of the farmers however, possibly most of them, will definitely reach the above-mentioned average and thus the average of the whole country will surpass the 200 kilograms per acre.

Thus, the above-mentioned yield of 200 kilograms are by no means excessive as the Institute achieved such an average for a long period of

time using fields less fertile than the average wheat producing field in Greece.

#### CONDITIONS NECESSARY FOR THE YIELD INCREASE

In order to achieve the higher yield and especially one similar to that achieved by the Institute of Cereals and some wheat producers, it is necessary that the interest of the producers be concentrated to the creation of the following basic conditions:

1. Timely and regular preparation of the wheat fields. (See our article, Wheat Sowing, GEOPOLITIKA, Nos. 110-11, 1963.)
2. Use of the proper variety and selected seeds.
3. Use of the indicated fertilizers.
4. The use of timely and regular sowing of the fields by using the indicated method of sowing and the use of the required quantity of seed per acre.
5. Systematic weeding in order to preserve moisture and nutritive elements for the exclusive use by the wheat plants.

#### 1. Timely and regular preparation of the wheat fields

The timely and regular preparation of the wheat fields is very important for the achievement of great potentials.

As a rule our farmers lack the required mechanical means for the regular preparation of the wheat fields and the result of this lack of mechanical instruments is that the farmer usually undertakes the preparation of his field only at the last possible moment. Therefore, the field is not cultivated, hoed or leveled properly. The covering of the seed is inadequate, part of it remains uncovered and is eaten by the birds, another part of it is ruined by rain pools formed by the poor hoeing, and most of the seed falls too deep or too close to the surface of the uneven field. Thus, while the farmer is expecting a normal germination growth and yield, quite the contrary happens, the field shows many bare spots which increase continuously because of the rain pools formed by the bad hoeing and uneven surface of the field.

The irregular germination which is the result of bad cultivation, i.e., lack of hoeing and leveling of the field, has a great influence on the wheat yield, as the bare spots are very seldom filled.

Such is the influence of the irregular hoeing of the field on the wheat yield that we may say that one of the basic reasons for the low wheat yield in Greece is mainly due to the generally poor preparation of

the fields and the lack of satisfactory hoeing and leveling of the fields which result in irregular germination of the seed and the appearance of many bare spots.

Therefore, our farmers should concentrate on the elimination of these causes. When these causes of poor sowing are eliminated, satisfactory conditions will be automatically created for the production of a better yield, provided that the other conditions necessary for a better yield -- which we will refer to later -- have been established.

We do not think that we need experimental data in order to persuade our farmers of the importance of the above-mentioned conditions. All farmers know very well how the wheat yields suffer in badly sown and hoed wheat fields, especially when followed by bad winters, i.e., too low temperatures, frost, etc., which prevent the normal growth of the plants, create many bare spots and influence adversely the yields.

## 2. Influence of seed variety on increased wheat yields

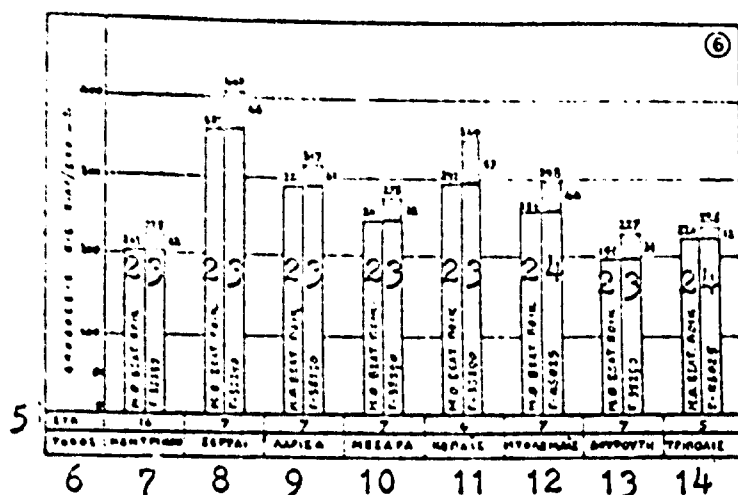
Following the preparation of the field for sowing, the seed variety used, its quality and, in general, the vitality of the seed is very important in the production of a good wheat yield, provided that the proper variety is used for the various areas of the country depending on the locality and fertility of the field. The farmer, therefore, is obligated always to seek with patience and acquire the best variety for his fields and especially a genetically pure seed of excellent quality and of high germinating qualities.

The importance of the variety in achieving high wheat yield is manifested by the statistics of the average yield of the varieties G-38290 and G-46025 used in the experimental stations of the Central Institute and its substations for a long period of time as compared to the average yield of all other varieties used for many years by the Institute.

For example, in experiments at the Central Institute where forty improved varieties were used for sixteen consecutive years in comparison with the control variety, the superiority of the variety G-38290 against all other varieties is 22 kilograms per acre. (Diagram 6 and 2.)

At the experimental stations of Serrai, Larissa and Messara, the yield of the G-38290 variety was higher by 46, 31 and 32 kilograms per acre than the average yield of all the other varieties used. (Diagrams 6 and 3a-3c.)

During the 1956-1962 experimental period, the difference between the G-38290 variety and the average yield of all other varieties at the experimental stations of Kopais was 5 $\frac{1}{2}$  kilograms per acre. (Diagram 6 and 5.)



Legend:

- 1 - Yield in kilos/acre
- 2 - Average - Improved varieties
- 3 - G-38290
- 4 - G-46025
- 5 - Years
- 6 - Place
- 7 - Central Institute
- 8 - Serrai
- 9 - Larissa
- 10 - Messara
- 11 - Kopais
- 12 - Ptolemais
- 13 - Douroute
- 14 - Tripolis

Diagram 6.

Increased yields achieved by the use of the most appropriate variety in relation to the field based on experimental data of the 1947-1962 period.

At the experimental stations of Douroute, Tripolis, and Ptolemais the achieved average yield of the variety G-46025 was higher than all other varieties used. The differences between the yields of the variety G-46025 and the other varieties during the experimental period of 1956-1962 were 31, 12 and 44 kilograms per acre. (Diagrams 6 and 4a-4c.)

The above statistics demonstrate the importance of the seed variety in high yield, and the need for the farmer's constant interest in selecting the variety most appropriate to the soil and climatic conditions of the field, and his preparation of the needed quantity of genetically pure seed with germinating efficiency. In case the farmer is unable to fulfill the above-mentioned requirements for securing the proper seed, he should refer to the agricultural services of the state for help.

A great increase in wheat yield is sought to be achieved throughout the country by the exclusive use of selected seed from improved varieties. Today, only 85% of the farmers use improved varieties and only 30% of them use seeds of selected quality and high genetic purity, while the rest of the farmers, i.e., 15% of them, continue to use local varieties. Of the 85% farmers, 70% of them continue to use seeds which have not been examined for genetic purity and germinating ability.

### 3. Fertilization as an agent of increased yields

The role of fertilization in the increase of the wheat yields in our country is more serious than it has been thought of until today because in a country like ours with poor soil, the germination is always poor, the organic substances placed in the soil are very few, the utilization of these organic substances are very quick and the resulting nitrogen is quite inadequate for the utilization of the productive

potentials of our soil without the addition of outside nutritional substances. This is especially true of those substances which are indispensable for the nutrition and normal growth of the plants, such as nitrogen and phosphorus, etc.

Thus, from experience we know that all fields in our country, with the exception of the very rich ones (which are very few), need chemical fertilizers in order to utilize their productive potential.

Which are the fertilizers needed by our fields? How and in what quantity should they be added in order to achieve the best yields? This is a very important problem which can be solved only by systematic local research. One thing is certain however, and that is that all the fields of our country need chemical fertilization and all fields should be fertilized intensively in order to produce the yields they are capable of producing.

The influence of fertilization on the wheat yield can be demonstrated by the experimental data on varieties and fertilization furnished by the Cereal Institute from experiments performed at the Central Institute for sixteen years (1947-1962) and at its substations for 5-7 years (1956-1962).

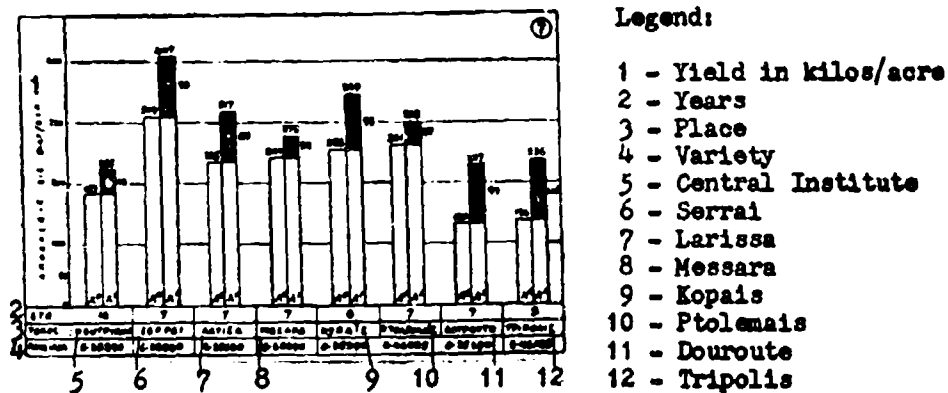


Diagram 7.  
Increase wheat yields by fertilization. Experimental data 1947-1962.  
(L<sub>0</sub> = control, L<sub>1</sub> = 6 units of nitrogen + 6 units of phosphorus.)

The above data shows that the nitrogen-phosphorus fertilization (6 units of phosphorus and 6 units of nitrogen per acre) increase the wheat yield according to the fertility and moisture in the soil. These data, nevertheless, are not the absolute rules for all fertilizations. Of course, the ideal fertilization system for each field would be the one supplying only the indispensable fertilizers, which can only be



achieved by a biological and if possible, laboratory test for each field on the findings of which the fertilization will be based. Fortunately, the Institute can also help the farmers in this respect by using a method specifying the fertilization needs of each field.

On the basis of the above-mentioned data, the increase of the wheat yield by fertilization is between 34 to 101 kilograms per acre. The higher increase being achieved in the poorest fields with sufficient moisture, and the smallest increase being noticed in the richest fields or fields unable to hold enough moisture for the utilization of the fertilizers.

From Diagram 7 we conclude that in the poor soils (Douroute, Tripolis, Messara) the increase in wheat yield achieved by fertilization is between 34 to 101 kilograms per acre and the percentage increase in relation to the control is between 77 to 14%.

In fields with moderate-to-good fertility with enough moisture (Serrai, Larissa) the increase in wheat yield caused by fertilization is between 82 to 98 kilograms per acre, i.e., 35% more than the control without fertilization. The percentage increase of wheat yield in these fields is smaller than that in poor fields, while fields without moisture (Central Institute case) the increase in wheat yield caused by fertilization is much smaller than the two cases mentioned above in kilograms per acre and in percentage (42 kilograms/acre = 23%).

On the basis of the above data regarding long term fertilization experiments, we may conclude that the increase in wheat yield caused by fertilization is very significant especially in soils of poor and moderate fertility with moisture. As most of the wheat fields in Greece are of poor and moderate fertility with enough moisture for wheat growth, we may conclude that fertilization is the most important problem facing the Greek farmer after the preparation of the field for seeding and the selection of the proper seed and the appropriate variety.

However, despite the fact that fertilization is one of the most important problems in wheat yield, it has not been properly faced by the farmers, either because they do not know of its great importance or because the farmers were unable to acquire the required fertilizers. For this reason, we should, in the future, emphasize the importance of supplying the required fertilizers and their reasonable use, so that wheat fertilization can be generalized and profitable. As the fertilization expenses are rather high, the farmer can profit from them only when the prescribed quantity and type of fertilizers are used.

The Cereal Institute has already outlined the influence of fertilizers on the yield in reference to quantity and type of fertilization. What is now needed is to find a convenient method of using the indicated fertilization for the various fields of the country, according to their fertility and the type of fertilization needed. If we can finally

succeed in this, we will be able to take a great step toward the solution of one of the most difficult problems -- the supply of reasonable wheat fertilization according to soil type, which has not been done till now and has resulted in the limited use of fertilizers with the known unfortunate consequences.

4. Sowing season, an important factor in yield increase.  
Method of sowing, quantity of seed, care.

After fertilization, good preparation of the soil, selection of seed for the appropriate variety, the season of sowing plays an important role in the production of a satisfactory yield.

The season for sowing cereals in all parts of Greece is in the Fall, but the date of sowing differs in the various counties, the various areas, and even the various fields within each area. In the cold areas, the sowing should take place early in the Fall, i.e., during the beginning of October; in the mountainous and very cold areas, during the beginning until the middle of October; in the moderately warm areas, the sowing should take place in November; and in the warmer areas during the winter or even during spring.

The sowing season may also be influenced by the variety to be used. Varieties needing cold for their growth should be sown earlier than the varieties of soft and hard wheat which do not need much cold. The borderline between these two varieties is rather limited but there is a definite difference between them.

The nature of the field may also influence the sowing season as moist and fertile fields may be sown later than the poor and dry fields whose sowing should, by rule, take place as early as possible.

In order to determine the most ideal sowing season for an area wherever there is no experience regarding this subject, we should perform experiments with various dates of sowing using the most common varieties in rich and poor fields, in dry and moist fields, etc.

In places with long experience, however, we may successfully determine the sowing season of cereals on the basis of this experience.

In order to give some idea as to the influence of the sowing season on the yield, we present below Chart 3 showing the influence of the various sowing seasons on the yield according to experiments at the Central Institute and its substations during the fifteen years (1947-1962).

**CHART 3**  
**Wheat Yield by Season in Experiments at the Central  
Institute and Its Substations**

VARIETIES	Sowing dates									
	Oct. 16-30		Nov. 1-15		Nov. 16-31		Dec. 1-15		Dec. 16-31	
	Kilos acre	%	Kilos acre	%	Kilos acre	%	Kilos acre	%	Kilos acre	%
<b>CENTRAL</b>	<b>Average 10 years</b>									
G-5770	-	-	194	106	183	100	169	92	-	-
G-38290	-	-	210	98	214	100	193	90	-	-
<b>PTOLEMAIS</b>	<b>Average 2 years</b>									
G-5770	168	120	140	100	167	119	-	-	-	-
G-38290	198	106	187	100	195	104	-	-	-	-
<b>SERRAI</b>	<b>Average 3 years</b>									
G-5770	-	-	273	110	247	100	227	92	-	-
G-38290	-	-	363	109	333	100	319	96	-	-
<b>LARISSA</b>	<b>Average 5 years</b>									
G-5770	-	-	244	102	239	100	229	96	-	-
G-38290	-	-	262	99	264	100	246	93	-	-
<b>KOPAIS</b>	<b>Average 2 years</b>									
G-5770	-	-	256	101	225	101	252	100	186	74
G-38290	-	-	336	89	383	102	376	100	314	83
<b>DOURROUTE</b>	<b>Average 2 years</b>									
G-5770	127	121	105	100	105	100	-	-	-	-
G-38290	143	100	143	100	123	86	-	-	-	-
<b>MESSARA (Fertile)</b>	<b>Average 2 years</b>									
G-5770	-	-	226	110	205	100	144	70	-	-
G-38290	-	-	236	98	240	100	176	73	-	-
<b>MESSARA (Poor)</b>	<b>Average 3 years</b>									
G-5770	-	-	-	-	163	120	136	100	82	60
G-38290	-	-	-	-	240	151	159	100	122	77

From the above statistics we may definitely conclude that, for the Central Institute area where the experiments were more systematic, the most appropriate sowing season for the variety O-38290 is November 15-30. After this period, the yield is reduced slightly when the sowing takes place in December and it is reduced considerably when the sowing takes place after December, i.e., in January, etc. Earlier dates for the above-mentioned variety may sometime prove fatal when the conditions immediately after sowing are exceptionally good for a successful growth but the conditions in spring are adverse for cereals that have grown too much, i.e., too low temperatures and spring frost destroy the wheat that has grown too much especially in the case of varieties susceptible to cold.

For hard wheat varieties, the most favorable dates for sowing seems to be the first fifteen days in November. After these dates, and especially as we approach winter, the sowing influences the yield adversely, while late sowing in December and January has a very adverse influence.

Of course, we cannot set definite dates for the sowing of each variety as the weather conditions may influence the sowing season decisively by delaying it several days from the ideal sowing dates established by our experiments. Nevertheless, we can definitely support the view that for each area, regardless of the weather conditions and the field and the variety used, there is an ideal date for sowing which is not too far from the dates established through long experience.

The farmer, therefore, should always try to achieve the best sowing season for his area which, regardless of all other conditions, will give him the greatest yield.

From the above we may conclude that the sowing season definitely influences the wheat yield and it should be taken into serious consideration by the farmers who wish to secure all possible conditions pertaining to a satisfactory increase of their wheat yield.

As a rule, the sowing dates should be established by the state services based on experimental data. Wherever there is no experimental data available, the dates should be based on long experience and observations, as these are the only criteria which may help the farmers best.

##### 5. Method of sowing, quantity of seed, care.

The method of sowing, the quantity of seed and the care after germination and during growth have an important influence on the yield. But which is the best method of sowing, what is the proper quantity, and what is the essential care for an ideal cultivation? The farmers are entitled to an answer to the above questions. The commonly used methods used by our farmers are sowing machines in lines, and broadcast by hand, covered later by a plow or harrow. Which one of these two methods is best?

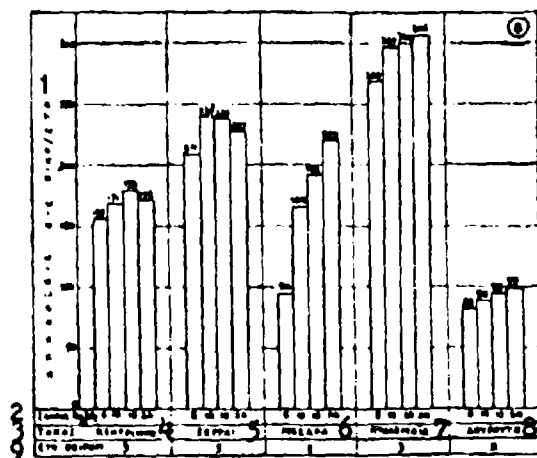


Diagram 8.

Influence of the amount of seed on the yield. (Experimental data of the Institute.) Legend: 1 - Yield in kilos/acre; 2 - Seed; 3 - Place; 4 - Central Institute; 5 - Serrai; 6 - Messara; 7 - Ptolemais; 8 - Douroute; 9 - Years of experimentation.

Experiments performed by the Cereal Institute, whose statistics are shown in Diagrams 8 and 9, proved that in the broadcast method, so long as the required surface unit seeding takes place and the seed is covered to the correct depth by plow or harrow, the yield will be the same as with that of the seeding machine. Therefore, both methods of sowing are equally good and produce the same yield as long as the sowing is done with care. When the required care is not given, both methods could be harmful to the yield. So, regardless of the method used, the farmers should be extra careful for a normal sowing and uniform coverage of the seed. Although both methods produce the same yield, we personally prefer sowing in line by a sowing machine, as this method is faster and more regular. The farmer should always strive for a more regular sowing which results in a uniform growth and consequently a higher yield.

How much seed should be used per acre? The amount of seed to be used is influenced by many factors. For instance, the nature of the soil, the sowing season, the regular or irregular preparation of the field, the variety, the rainfall and many other secondary factors. As a general rule, however, the experiments at the Institute showed (Diagram 8) that the amount of seed for all varieties in all cases should be between 12 to 18 kilograms per acre. Quantities less than 12 kilograms per acre did not always give satisfactory results, while amounts over 18 kilograms per acre, in rare cases only, gave higher yield, as for instance, in the very cold areas, where due to the cold there is a considerable number of bare spots.

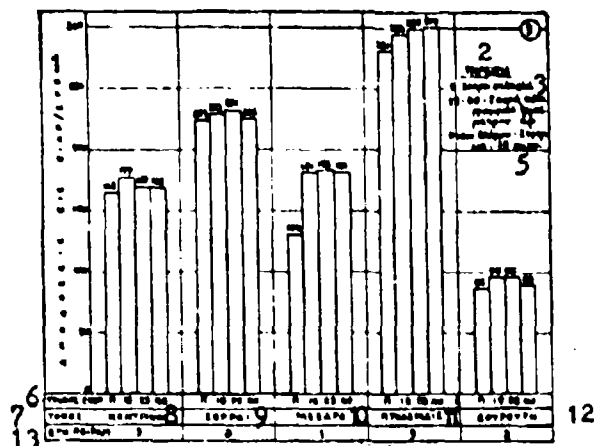


Diagram 9.

Influence of the sowing method on the yield as based on the experimental data of the Institute. Legend: 1 - Yield in kilos/acre; 2 - Methods of sowing; 3 - Broadcast method; 4 - Sowing in rows; 5 - Amount of seed per acre: 15 kilos; 6 - Method of sowing; 7 - Place; 8 - Central Institute; 9 - Serrai; 10 - Messara; 11 - Ptolemais; 12 - Douroute; 13 - Years of experimentation.

On the basis of the above-mentioned experimental data of the Institute, it is proven that the farmer should always follow those amounts which were proven most profitable which, according to the chart, are between 12 and 18 kilograms per acre. These amounts may be changed upwards or downwards depending on the sowing season, the nature of the field, its good preparation, the specific weight of the seed and the conditions which will follow immediately after the sowing, etc.

When the sowing is done by machine, the distance between the rows should always be 20 to 30 centimeters. Longer or shorter distances do not give better yields, and sometimes even deteriorate the production.

#### 6. Other treatments. Surface fertilization, weed control.

Following the regular germination of the sown seed, the wheat should be strengthened by nitrogen fertilization during all stages of development. Nitrogen should be added especially when there are symptoms of regressing growth in order to keep the plants growing by all means in both winter and spring. Therefore, whenever chlorosis appears, due to winter rainfall, low temperatures, etc., the farmer should try to retain good growth by being ready to fertilize the plants.

The farmer should also take all the necessary means to keep the field clear of any weeds which often adversely influence the end result, as these weeds compete with the wheat for the soil nutritives and moisture and especially at times when these indispensable elements are in the soil in very insufficient quantities (critical periods).

The weeding should take place by any available means and at all times so that the field will remain free of weeds always.

Finally, the yield will be influenced by the presence of weeds in the field during the growth of the plants.

#### CONCLUSIONS

The conclusions of our study are as follows:

1. The productive potential of the Greek fields in wheat yield has not yet been fulfilled. On the contrary, it is possible to achieve higher yields, reaching 200 kilograms per acre now, and surpassing them at a later date.
2. The existing potentials of the Greek soil may be fulfilled as follows:
  - a. Proper preparation of the field for sowing; proper hoeing and leveling so as to achieve good germination throughout the field; and good growth during the winter without bare spots by rain pools and other causes of bad sowing.
  - b. Use of selected, appropriate varieties for each area with high germinating ability. Our farmers have not as yet paid attention to this matter.
  - c. Reasonable fertilization according to the real needs of each area, regardless of the locality, sowing and fertility of the field. At present, most fields are not fertilized and some are fertilized insufficiently and at random.
  - d. Sowing of the fields at the best season by a method that will result in regular germination and vital growth -- the basic factors for high yield.
  - e. Keeping the fields in good condition, nitrogen fertilization, and preservation of the growth of the plants, so as to fulfill the ambitions and hopes of the farmer.
  - f. Using all possible methods to retain the soil's moisture by keeping the field clear of all weeds during the entire growing period of the plants and especially during the critical periods.